Leveraging Public
Data to Reconstruct
the Cost History of
Planetary Exploration

Casey Dreier
Senior Space Policy Adviser
The Planetary Society





### **Motivations**

- Publicly-reported mission costs are inconsistent and lack detail
- Comparisons are difficult between missions and over time
- A problem for both public education and advocates:
  - Press kit numbers are what gets reported!
  - How much "should" a mission cost?
  - How to interpret the total cost—is a \$1B mission "expensive" or "a good deal"?
  - How much is a mission in the context of all planetary spending? Or all of NASA spending?
  - How much of a mission cost are development, launch, and operations?

#### MSL Curiosity Press Kit:

Cost: \$2.5 billion, including \$1.8 billion for spacecraft development and science investigations and additional amounts for launch and operations.

#### Perseverance Press Kit:

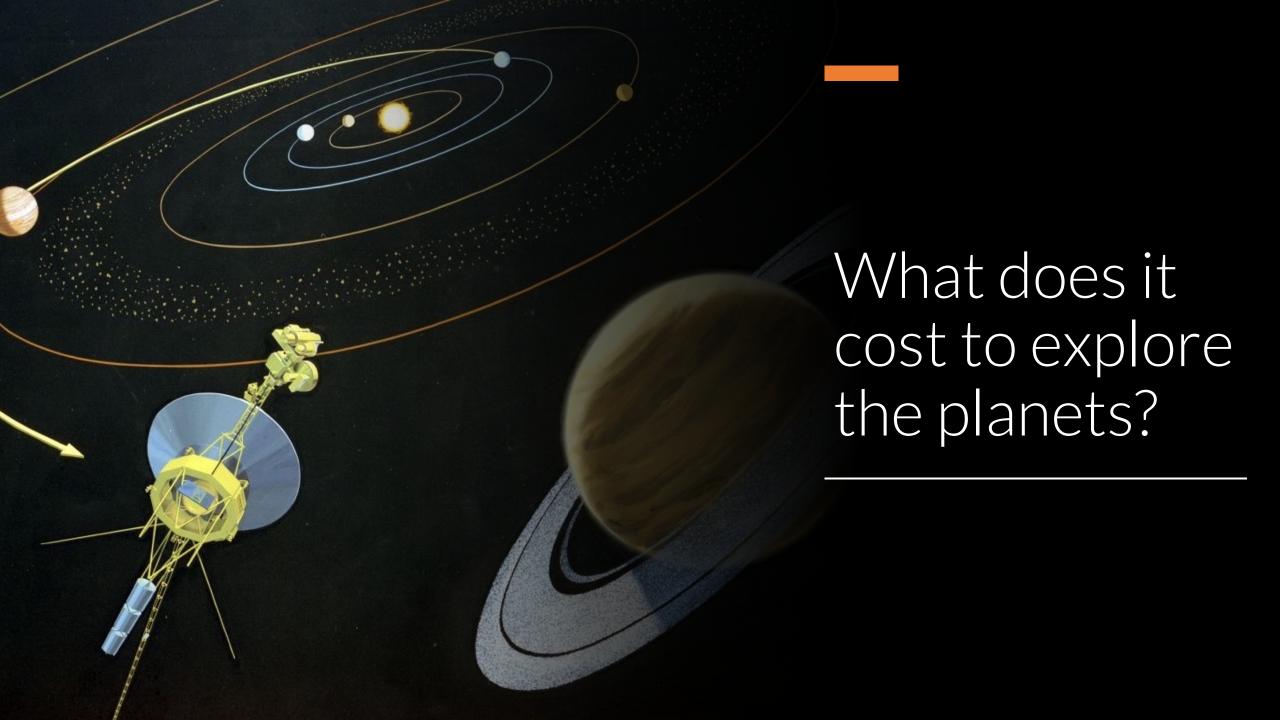
NASA has invested approximately \$2.4 billion to build and launch the Mars 2020 Perseverance mission. The estimate to land and operate the rover during tis prime mission is approximately \$300 million.

#### Voyager Press Kit:

Estimated cost of the Voyager project, exclusive of launch vehicles, tracking and data acquisition and flight support activities is \$320 million.

#### Juno Press Kit:

The Juno mission investment is approximately \$1.1 billion in total. This cost includes spacecraft development, science instruments, launch services, mission operations, science processing and relay support for 74 months.



## **Project Goals**

- Compile a complete record of mission and program costs for NASA's robotic planetary program using public data.
- Useful for public and public policy discourse:
  - Normalized to include accounting changes
  - Include all mission costs: development, launch, and all operations
  - Inflation-adjusted values
  - Provide costs by year
- Easily and freely accessible



## Method

- Primary source: NASA budget estimates provided by NASA HQ History Office
- Used "actual" reported obligations
- Augmented by a variety of secondary sources, in order of preference:
  - Official NASA statements (press releases, public briefings)
  - Projected values in PBRs
  - Reporting from high-quality news agencies
- Normalizations ("gap fill" strategy):
  - Include all LV costs, except STS
  - Removed Deep Space Network overhead
  - Restore "gaps" of mission funding (i.e. correct for temporary accounting changes)

National Aeronautics and Space Administration



#### **BUDGET ESTIMATES**

FISCAL YEAR 1963

CONSTRUCTION OF FACILITIES
PART 1



National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1972

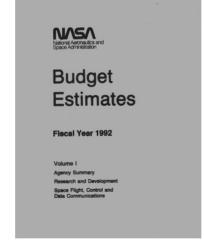
Volume 1



#### Budget Estimates

FISCAL YEAR 1986

Volume I Agency Summary Research and Developmen











## Results

- Worked pretty well!
  - Reconstructed a reasonable data set from 1960 onward
- Google Sheet as prime source
  - <a href="https://www.planetary.org/space-policy/planetary-exploration-budget-dataset">https://www.planetary.org/space-policy/planetary-exploration-budget-dataset</a>
  - versioned, exportable to popular formats (xlsx, csv, open office)
- Inflation adjustments
  - NNSI for R&D
  - Employment Cost Index for operations after 2001

PULS \$148.2 \$2 60.0 \$1 292.5 \$148.2 \$0	10 1031 119 99EL1	904.5 \$948.7	9040.2 \$1,400	991.4 3 \$90.0	511.1 5481.8	914.3 98348	SECO RUBAL	51.5 50'5.8	501.3 5001.1	53.3 5096.5	923 903	\$04.8 \$96.1 \$96.1 \$9.5 \$9.5 \$9.0 \$9.0 \$9.0	\$21 \$21 \$36.4	\$101.5 9030.7	103 507	\$9.7	584	NO.3	55.5 555.4	58.3 9128.5	\$270.5 \$270.5	571.2 5791.2	\$277.7 \$406.5	99.7 \$ML3	\$130.7 \$195.9	1772.0	\$(00.0 \$(0.00.0	\$1903 \$2904	SCS SIELA	\$16.3 \$296.8	9180.7 91,892.3	\$495.5 \$2,945.2	901.8 \$296.3	SSP.3 Sente	\$344.1 \$1,000.8	\$12.4 \$430.8	\$12.8 \$1940	542 5290
										\$43 \$203 \$985 \$728 \$653 \$900		\$03 \$13 \$13	\$7.1 250.0 500.4 500.7 \$2210 \$760.6 \$87.6 \$88.0			\$948 \$38.4 \$962 \$3.3 \$4.6	903 901 814	90.1 90.9 90.1 93.7 93.2	804 885 873 873	80.8 80.4 80.4 80.3 81.3																	86.8 80.6 896.8 89.3 80.7 86.3	8072
			121.0 110.7 110.7 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1 101.1											\$28.8 90.5 906.3 906.3 906.2 906.2 906.2 906.3 906.4 \$13.8								\$03 \$03 \$05 \$03 \$03 \$03 \$084 \$044 \$044															96.4 90.6 90.6 90.7 90.3	9073 9033 9034 9054 9054 9053 907 907 907 907 907 907 908 908 908 908 908
005 005 005 005 005 005 005 005 005 005	110 1364 1565 1669 1669 1664	814 803 8103 8104 886 886 886 873 873 873 873 873 873 873 873 873 873	\$10.00 \$1	804 80.7 9 80.8 9 80.8 9 20.6 2 80.3 9 10.3 9 10.3 9 10.3	311		83.7 961.4 967.6				DR.4 DOS B67 E03			\$412 \$633 \$651 \$14 \$14								Some Some Some Some	BALO EDIAS E	\$11 \$100.0 \$000.4 \$67.1 \$11.8 \$4.6	853	BALE BALE BALE BALE BALE BALE BALE BALE	1040 1040 10714 10724 1073 1003 1003	\$14.6 \$60.0 \$2.0 \$11.1 \$12.6 \$1.1 \$10.0 \$1.0 \$1.0 \$1.0 \$1.0 \$1.0 \$1.		\$10.6 \$106.2 \$20.6 \$27.2 \$6.0	\$10.0 \$86.0 \$100.0 \$100.0 \$100.0 \$60.0 \$60.0	81.7 80.4 879.1 879.2 889.0 849.0	9013 9064 9064 913 913 914 913 914 915 916 916	807 804 804 8061 8061 8074 8074		FO.1 FIG.3 F	\$1.2 \$1.5 \$1.5 \$1.5 \$1.6 \$4.1 \$4.6 \$4.6 \$4.6 \$4.6 \$4.6 \$4.6 \$4.6 \$4.6	91 - 91 - 91 - 91 - 91 - 91 - 91 - 91 -
13 13 66 68 69 69 69 69 69 69 69 69 69 69 69 69 69	110 100 100 100 100 100 100 100	103 103 500 510	\$100.0 \$175.0 \$657.4 \$665.6 \$465.6		913 9011 91029 91041 9104 9104 9208 918 918	\$23 \$627 \$622 \$693 \$693 \$614 \$614	90.7 90.4 90.3 90.3 90.3 90.1 90.1 90.3 90.3 90.3 90.3 90.3 90.3	98.1 982 982 983 995 985 987 98.5	\$3.3 \$64.5 \$01.4 \$100.5												\$16.4 \$61.3 \$791.6 \$341.5 \$401.2 \$101.6 \$101.1		Base Brase B		90.0 90.7 90.7 900.1 900.5 900.5 900.5 900.6 900.6 900.6 900.6 900.5	200.3 205.9 502.7 504.9 504.0 504.0 504.0 504.0	\$10.0 \$277.0 \$177.4 \$177.4 \$10.3 \$10.3 \$10.3 \$10.3 \$10.0 \$10		900 900 904 900 945 900 945 900 940		201.0 201.0	90.5 90.6 975.1 975.3 995.6 996.6 996.6 996.6 996.6 996.6 996.6 996.6 996.6		807 8034 8034 8161 8163 8173 8173 8174 8174 8175 8164 8175 8164 8175 8184 8185 8184 8184 8184	\$43 \$425 \$205 \$200 \$100 \$100 \$45 \$45 \$45 \$45	10		
Official LCC	Fiscal Year	1	Formul	lation	0	eve	lopn cl L\			Laui Serv			Ope	ratio	ns		Tota	l Co	st		Total C			No	tes				16.5					100				
\$720	200	1	\$12			(	J	,		-			-			İ		2.0	-	(	\$18.																	
	200	3	\$58	.0			146.9										\$1	8.0 46.9			\$86. \$214	.5	KE	P-C:	July	200	2											
	200						185.5 143.7											85.5 43.7			\$261 \$196		La	unch	: 12	Aua	2005	5										
	200	_				Ψ.	140.7						\$	46.4				6.4			\$64.			ars ar					06									
	200													47.6				7.6			\$64.																	
	2008													38.9 23.9				8.9			\$50. \$30.																	
	201	_												23.2				3.2			\$28.																	
	201	-1												30.1				0.1			\$36.		En	d prii	me n	nissio	on: D	ec 2	010									
	2012													39.9				9.9			\$47.																	
	2013													20.6				0.6			\$24.																	
	2014													29.2 27.9				9.2			\$33. \$31.																	
	201													27.7				7.7			\$30.																	
	201	7											\$	28.0			\$2	8.0			\$30.	3																
	2018	_												26.3		-		6.3			\$27.																	
	2019	_												26.0		-		6.0			\$26.																	
	202													28.0 25.5		H		28.0			\$28. \$25.																	
	202													25.0				25.0			\$25.																	
	202	3											\$	24.5			\$2	4.5			\$24.	5																
	202													23.5				3.5			\$23.																	
T	202	5	4=-	•	-		170					-		23.5		$\vdash$		3.5			\$23.				4.								1000000	e				
Totals		1	<b>\$70</b>				<b>176</b> .1 37%	16		\$9	U			5 <b>85.</b> 7 52%			<b>ֆ1,</b> 1	131.8	•		\$1,45	5.5											specii on. %				pera	tion
		-1											·	_,,			R	te	qu	es	st							ed							tu			
					R	es	ea	arc	h	&	Aı	na	lys	sis	3			\$	54	.5													\$	6	1.	5		
			F	Pla	ne	ta	ıry	sı	qı	ро	rtir	ng	R	&٦				\$:	37	.9													9	64	5.	1		
Advanced Programs							8			9.	.0														\$9	9.5												
						٨	Лa	rs	D	ata	a A	na	aly	sis	8			\$	4.	3														\$3	3.1			
			Hall	ley'	's	CC	m	et	in	ve	sti	ga	tic	ns	8			\$	3.	3														\$3	3.8			
											(	Ga	lil	ec	)			\$	56	.1													9	5	8.	В		
								M	ar	s	Ob	S	erv	/e	r	\$16.0														9	1	3.0	0					
	Magellan							1			\$	92	.5													\$	9	2.	5									

## What it contains

• Requested AND obligated amounts for NASA's robotic planetary program for each fiscal year since 1961

#### Mission tabs:

- annual obligations for nearly every major planetary science mission
- includes development, launch, and operations

### Summary tables:

- Total planetary program request and actual per year since 1959, with congressionally-enacted amounts since 2008
- Spending by prime destination (Venus, Mars, Outer Planets, etc)
- Timeline entries of every mission, with LV type and cost
- "Decadal period" summaries

SUPES	9145.2 951	990E1	965 9HL)	\$6,496.7	11,003	SHU	SHEE	NO.	RINI	503x	5001.1	548 548 500 500 500 500 500 500 500 500 500 50	903	504.8 89.5 96.5 80.6 57.5 80.3 97.0 97.0	\$2.5 \$2.5 \$00.4 \$00.4 \$100.7 \$120.0 \$210.6 \$210.0	SHA!	193 97	\$90 \$14 \$16 \$10 \$1 \$14	903 903 904	50.1 50.1 50.1 50.1 50.1	50.5 500.4 500.6 500.6 500.5 57.3 57.3	583 1685 1685 1685 1685 1685 1685 1685 1685	101 1079.5	SOUL SOUL	90°C) 9406.1	SHL)	1953	boes z	\$000	100.4	Inte	trice	953963	n NEPOZ	129.3	SHILE	\$1,000	900	500 500 500 500 500 500 500 500 500 500	2 80 2 4 4 4 4 4 2 2 3 4 1 4 1
\$00 6. \$446.4. \$256.2. \$256.2. \$256.5. \$256.5. \$256.5. \$256.7.	80.4 84.8 80.3 80.7 80.7 80.7 80.7 94.6 94.6 94.6	#100 #862 #863 #863 #863 #863 #863 #863 #863 #863	81.8 803.8 804.2 806.6 1 806.6 1 106.8 1 106.8 1 107.8 1 107.8	\$490.0 \$490.0 \$490.0 \$490.0 \$490.0	8114 1903 1 1903 1 1903 1 1903 1 1904 1 1905 1 1904 1 1905 1 1905 1 1906 1	863 803 803 903 904 914 913 913 913 913	P13 9675 9675 9750 9750 9750 9750 9750 9750 9750 97	923 9627 9628 9639 9640 9640 9640 9640 9640 9640 9640	10.7 30.4 30.5 30.5 30.7 50.7 50.7 50.7 50.7 50.7 50.7 50.7 5	86.1 800.2 900.2 900.2 900.2 900.2 900.2	53.0 504.5 504.6		Disk   Disk   Mar   Disk   D			504 505 505 505 505 505 505 505 505 505							5M4 - 596.3 577.0 534.6 546.6 546.6 546.6	903 503 503 503 503 503 503 504 504 504 504	880.0 197	85.1 (506.3 (500.4 (507	96.5 80.5 96.5 96.1 96.5 96.5 96.5 96.5 96.5 96.5 96.5 96.5	81.7 184. 187.4 184.3 187.7 184.3 187.7 184.9 18	200.0 200.0	6448 8460 8488 8484 8441 8411 842 842 842 843 843 843 843 844 844 844 844 844 844	96.0 (10.0 (	2006 2016 2016 2017 2010 2010	10.8 386.6 386.6 100.1 1	BL7 BGG BTM1 BTGS BHGG SUB3 SUB3 SUB3 SUB3 SUB3 SUB3 SUB3 SUB3	913 964 184 1813 1813 1803 1804 180	827 1906 1906 1907 1907 1907 1907 1907 1907 1907 1907	94.5 99.5 99.5 509.6 509.6 509.6 509.6	POST PARTE P	53 54 54 54 54 54 54	
Off	ficial CC	Fisc	al		mula	ation	D	evel	opm			Laui Serv			One	ratio	ne	Ι,	Total	Cos			otal C		\$re.6	No			\$1.5		96.9		\$36.0	9011		992	990.3			
	720		001		\$12.0			(inc	CI LV	)		Serv	ices		Ope	ratic	ns			2.0	st	(ini	\$18.			NO	tes													
			002		\$58.0	0		61	46.0											8.0			\$86.		KD	P-C:	July	200	2											
			003						46.9 85.5											46.9 35.5			\$214 \$261																	
		20	005						43.7										\$14	43.7			\$196	.7	Lau	ınch.	12	Aug .	2005											
			006													46.4		-	\$4				\$64.		Ma	rs ar	rival:	10	Marc	h 20	06									
-			007													47.6 38.9			\$4 \$3	7.6			\$64. \$50.																	
			009													23.9				3.9			\$30.																	
			010													23.2				3.2			\$28.																	
			011													30.1			\$3				\$36.		En	d prii	ne n	issio	on: D	ec 2	010									
			012													39.9				9.9			\$47.																	
			013													20.6 29.2			\$2 \$2	9.2			\$24. \$33.																	
			015													27.9			\$2				\$31.																	
			016													27.7				7.7			\$30.																	
			)17													28.0				8.0			\$30.																	
			018													26.3 26.0				6.3			\$27. \$26.																	
			020													28.0 28.0				8.0			\$28.																	
			021													25.5				5.5			\$25.																	
		20	022												\$	25.0			\$2	5.0			\$25.	0																
			023													24.5				4.5			\$24.																	
			024													23.5		-		3.5			\$23.																	
Т	otals	20	025		\$70.0	0	+	\$4	76.1	8		\$9	0	+		23.5 <b>85</b> .7	,	$\vdash$	\$1,1	3.5 31.8	3		\$23. \$1,45		Pre	ess k	it spe	cifie	s \$9	OM f	or la	unch	, but	not :	spec	ified	in P	BRs		
					13%				7%							52%			,.				,									. imp							per	atio
																			R	e	qu	es	st			1	Er	ıa	ct	ed	1				A	C	tu	al		
							Re	es	ea	arc	h	&	Α	na	lys	sis	3			\$!	54	.5													5	\$6	1.	5		
					P	laı	ne	ta	ry	sı	цр	ро	rti	ng	R	&1	-			\$3	37	.9													5	\$4	5.	1		
Advanced Programs								3			\$	9.	0														\$9	9.5	5											
								N	1a	rs	D	ata	a A	na	aly	sis	3			\$	4.	3														\$3	3.1			
				На	alle	ey'	s	СО	m	et	in	ve	sti	ga	tic	ns	3			\$	3.	3														\$3	3.8	3		
														Ga	lil	ec	)	200000000000000000000000000000000000000															5	\$5	8.	8				
										M	ar	s	Ok	os	erv	/ei	r	\$16.0														:	51	3.	0					
													M	ag	ell	ar	1			\$	92	.5													5	59	2.	5		

### MSL Curiosity mission tab

Official LCC	Fiscal Year	Formulation	Implementation	Launch Services	Operations	Total Cost	Total Cost (inflation adj)	Notes	
\$2,476	2002	\$5.7				\$5.7	\$8.5	Finall LCC and	d other useful data in the NASA OIG report: https://oig.nasa.gov/docs/IG-11-019.pdf
	2003	\$60.6				\$60.6	\$88.5	Began formula	tion: September 2003
	2004	\$118.1				\$118.1	\$166.6	Mission Conce	ppt Review: Oct 2003.
	2005	\$117.5				\$117.5	\$160.9		
	2006	\$213.6	\$37.4			\$251.0	\$333.1	KDP-C: August	t 2006. Original LCC: \$1.8 billion. Note: small adjustment to match final Formulation amount, sli
	2007		\$416.8			\$416.8	\$532.7	CDR: June 200	07
	2008		\$545.0			\$545.0	\$672.5		
	2009		\$229.3			\$229.3	\$277.7	Project Rebase	eline: 23 Feb 2009. Original launch date Sept 2009.
	2010		\$258.4			\$258.4	\$308.8		
	2011		\$242.9			\$242.9	\$285.7		
	2012		\$174.0			\$174.0	\$202.4	Launch: Nov 20	6 2011. Landing Aug 2012.
	2013				\$63.8	\$63.8	\$76.8		
	2014				\$69.6	\$69.6	\$82.2	Prime mission	end: Summer 2014
	2015				\$63.5	\$63.5	\$73.5		
	2016				\$50.3	\$50.3	\$57.0		
	2017				\$56.2	\$56.2	\$62.4		
	2018				\$51.4	\$51.4	\$55.7		
	2019				\$51.1	\$51.1	\$53.9		
	2020				\$50.0	\$50.0	\$50.0		
	2021				\$40.0	\$40.0	\$40.0		
	2022								
	2023								
	2024								
	2025								
Totals		\$515.5	\$1,903.8	\$194.7	\$495.9	\$2,915.2	\$3,588.8	Launch cost es	stimate from: https://www.nasa.gov/centers/kennedy/news/releases/2006/release-20060602d.htm
		21%	79%		17%			% dev spent or	n formulation vs. implementation. % TOTAL on operations

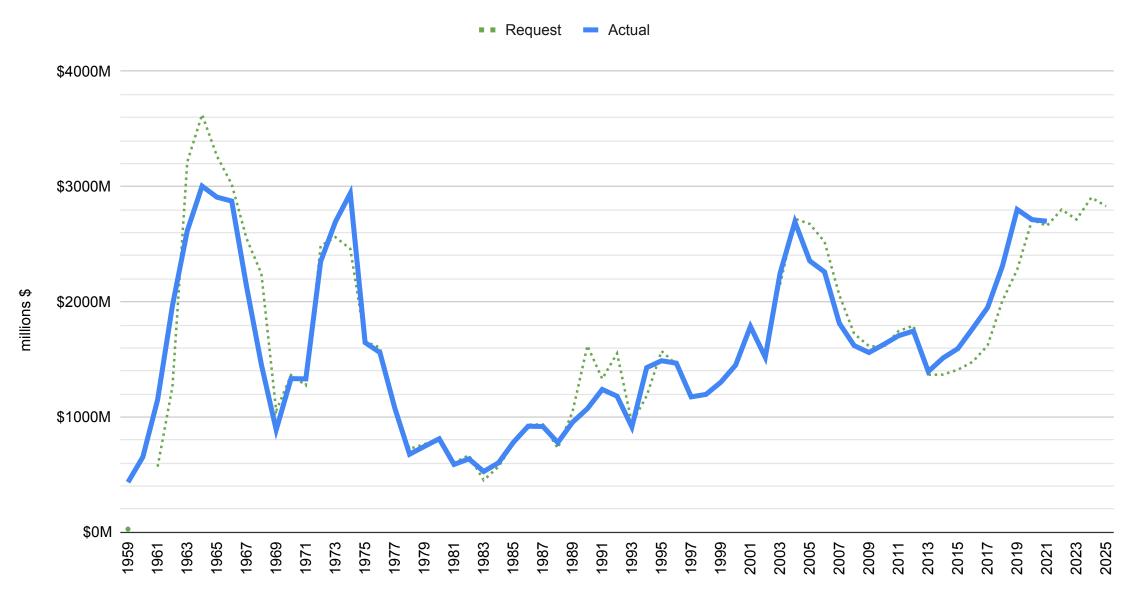
### Example of a Fiscal Year tab, FY 1987

	Request	Enacted	Actual	Notes				
Research & Analysis	\$63.5		\$69.5	Using "amend	ded" FY87 budget	estimates		10
Planetary supporting R&T	\$47.4		\$46.1					
Advanced Programs	\$10.1		\$16.6					
Mars Data Analysis	\$2.9		\$2.9					
Halley's comet investigations	\$3.1		\$4.0					
Galileo	\$77.0		\$71.2					
Mars Observer	\$62.9		\$35.8					
Magellan	\$69.7		\$105.3					
Ulysses	\$24.0		\$10.3					
Mission Operations & Data Analysis	\$77.2		\$75.1					
Ulysses	\$0.3							
Pioneer Programs	\$8.3		\$8.3					
Voyager/Neptune mission (Voy 2)	\$30.3		\$26.1					
Voyager Extended Mission (Voy 1)	\$4.8		\$2.8					
Flight Support	\$33.5		\$37.9					
STS Operations	\$66.3		\$23.6	STS costs inc	cluded here for refe	erence but NOT	included in progi	am totals
Mars Observer	\$9.1		\$0.0					
Galileo	\$22.0		\$11.8					
Magellan	\$22.0		\$11.8					
Ulysses	\$13.2		\$0.0					15
Total	\$374.3		\$367.2					

### Summary table example: spending over "Decadal Survey-equivalent" periods

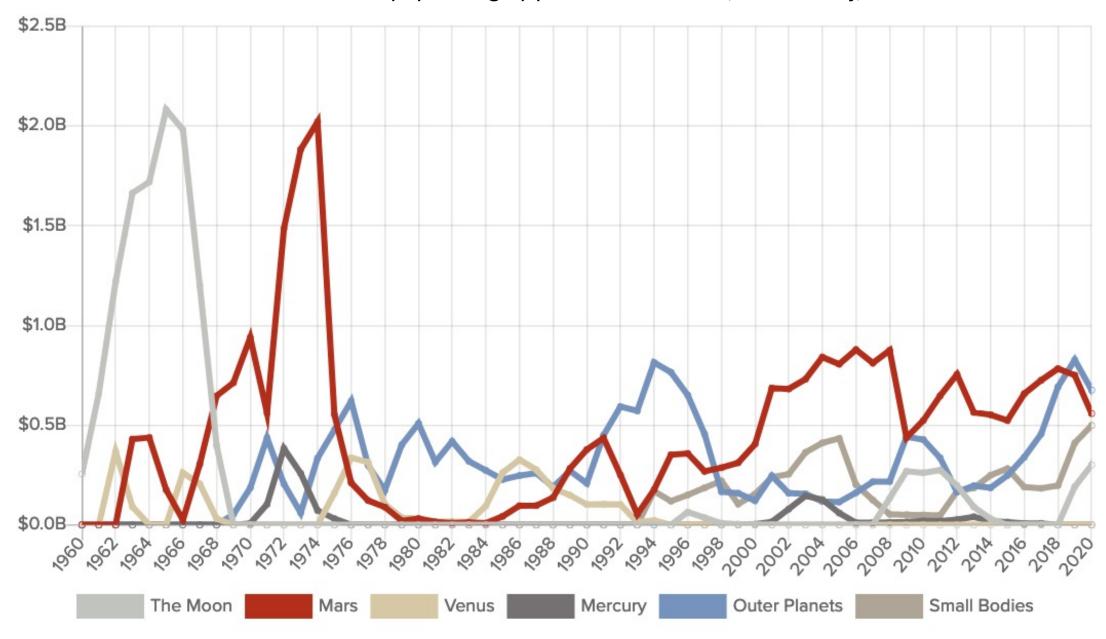
		Decadal Survey Equivalent Periods (2020 \$)										
Destination	1960 - 1962	1963 - 1972	1973 - 1982*	1983 - 1992	1993 - 2002	2003 - 2012	2013 - 2022	Total				
Mercury	\$0	\$494	\$361	\$0	\$97	\$445	\$87	\$1,484				
Venus	\$367	\$588	\$1,107	\$1,614	\$35	\$0	\$0	\$3,712				
The Moon	\$2,133	\$9,047	\$0	\$0	\$111	\$1,137	\$1,581	\$14,010				
Mars	\$0	\$5,717	\$5,017	\$1,738	\$3,578	\$7,307	\$6,252	\$29,608				
Small Bodies	\$0	\$0	\$0	\$0	\$1,597	\$1,903	\$2,808	\$6,308				
Outer Planets	\$0	\$880	\$3,746	\$3,038	\$4,109	\$2,352	\$5,208	\$19,333				
Research/Overhead/Other	\$1,270	\$4,170	\$3,535	\$2,583	\$4,200	\$6,489	\$5,570	\$27,816				
Program	1960 - 1962	1963 - 1972	1973 - 1982	1983 - 1992	1993 - 2002	2003 - 2012	2013 - 2022	Total				
Ranger	\$1,596	\$1,308	\$0	\$0	\$0	\$0	\$0	\$2,904				
Surveyor	\$537	\$5,648	\$0	\$0	\$0	\$0	\$0	\$1,162				
Lunar Orbiter	\$0	\$2,091	\$0	\$0	\$0	\$0	\$0	\$2,091				
Pioneer	\$0	\$1,664	\$1,659	\$187	\$38	\$0	\$0	\$3,549				
Mariner	\$1,278	\$4,935	\$410	\$0	\$0	\$0	\$0	\$6,120				
Discovery	\$0	\$0	\$0	\$0	\$2,077	\$2,371	\$3,398	\$7,847				
Mars Surveyor/Exploration Program	\$0	\$0	\$0	\$0	\$3,041	\$7,231	\$5,428	\$15,700				
New Frontiers	\$0	\$0	\$0	\$0	\$0	\$2,202	\$1,982	\$4,184				
Total Planetary Program	\$3,770	\$20,896	\$13,765	\$8,973	\$13,728	\$19,633	\$21,506	\$102,320				
			*includes 1976 7	rQ								

#### NASA's Robotic Planetary Program Totals (inflation adj)

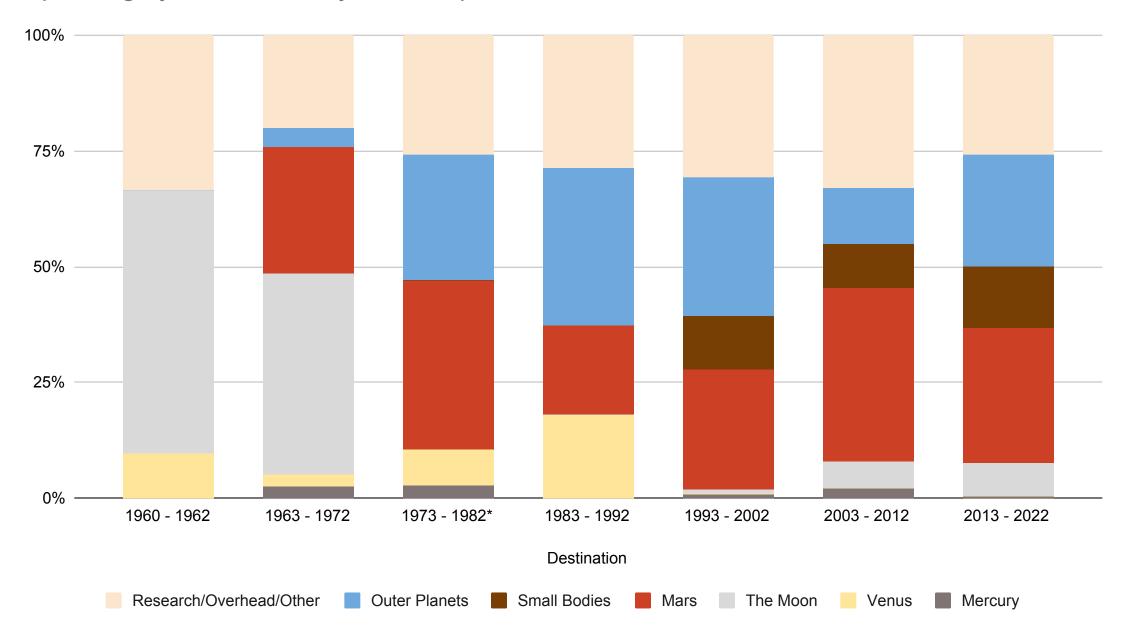


Fiscal Year

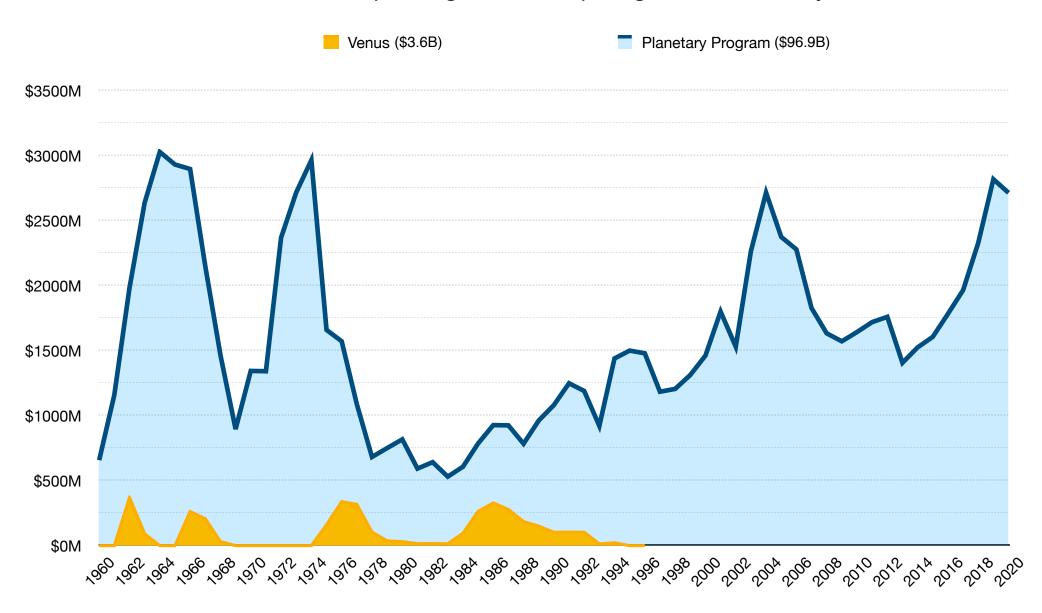
NASA Planetary spending by prime destination (inflation adj)



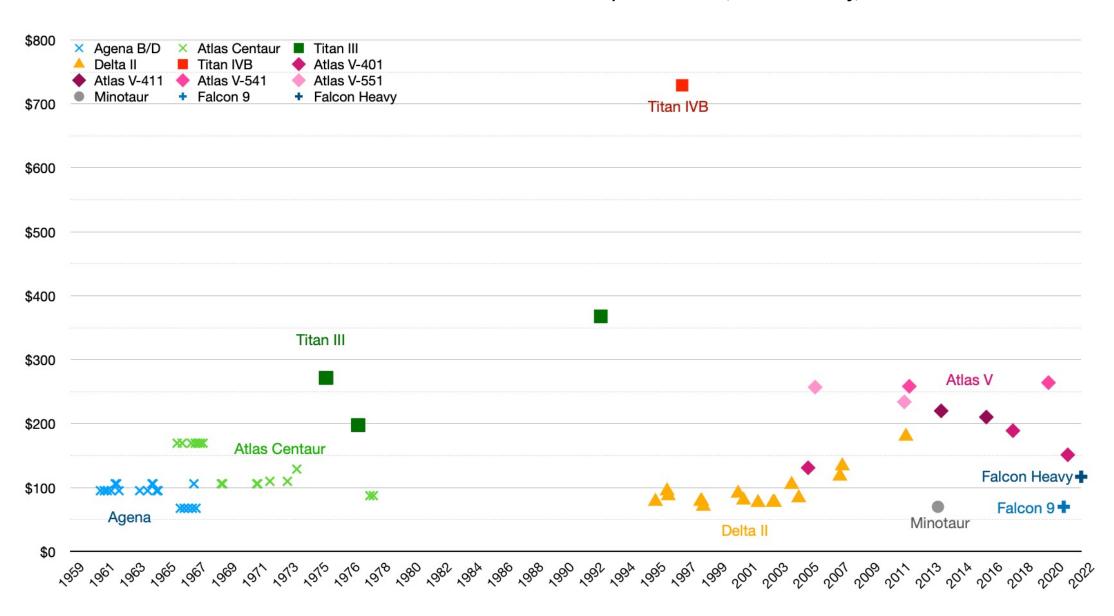
### Spending by destination, by decadal period



#### NASA Venus Spending vs Planetary Program (inflation adj)

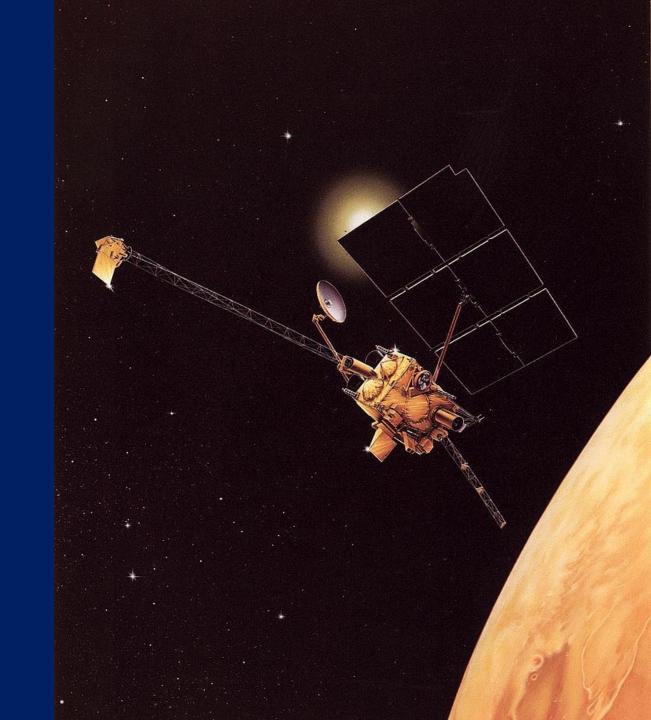


#### Launch Vehicle Costs for Planetary Missions (inflation adj)



## **Caveats**

- Only as good as the reporting in budget estimates
- Obligations don't track outlays, and don't track contract revisions/alterations
- Certain eras have more detail than others
  - From FYs 1998 2003 planetary programs grouped with all space sciences,
  - 2004 2012 operating costs grouped in single account
  - LV costs during the 1960s are hard to tie to specific missions in a program series
  - 1959 1960 is what you'd expect
- No normalization possible for full-cost accounting change in FY2004
- Data is granular to the fiscal year



### Outcome

- Data integrated throughout planetary.org and Wikipedia.
- Immediate and ongoing interest by media organizations, academia, and industry in the dataset and related products.
- Public budget data is relatively robust if you put in the time to compile it! Very transparent.
- Cost reporting from non-NASA entities pale in comparison.







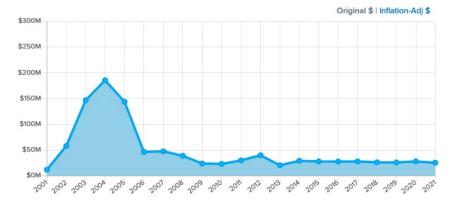




#### Cost of the Mars Reconnaissance Orbiter

The Mars Reconnaissance Orbiter (MRO) cost \$716.6 million, of which \$416.6 million was for spacecraft development, \$90 million was for its launch, and \$210 million was for 5 years of operations during its primary mission. After beginning its extended mission in 2011, MRO's annual operations costs are, on average, \$31 million per year, when adjusted for inflation.

During its development and primary mission from 2001 to 2010, MRO accounted for 0.0028% of all spending by the United States.



Mars Reconnaissance Orbiter costs per fiscal year The project began formulation in 2001 and entered the implementation (build) phase in 2003. The orbiter launched in August 2005 and entered Mars orbit in September of 2006, where it has been in operation ever since. Source: Planetary Science Budget Dataset, compiled by Casey Dreier for The Planetary Society (accessible on Google Sheets or downloadable as an Excel file).

Development	\$416.6 million
Launch Vehicle (Atlas V 401)	\$90 million
Prime Mission Operations (5 years)	\$210 million
Total	\$716.6 million
Extended mission operations (avg)	\$31.6 million / year (inflation adjusted)

## Feedback Welcome

- How can these data be better...
  - Interpreted?
  - Improved?
  - Presented?
- What other caveats should be included or accounted for?
- What other data sources should be considered or requested?

## Acknowledgements

- Jason Callahan for top-line Planetary program levels for FYs 1998 – 2001 "Budgeting for Exploration: History and Political Economy in Space Science 1959-2010" Presented at the AAS 45th Meeting of the Division for Planetary Sciences, Denver, Colorado. October 7, 2013.
- NASA HQ History Office for digitizing and providing 50 years of NASA Budget Estimates.
- Special thank you to Planetary Society member/volunteer Shannon Bertolino for data validation.

# THEPLANETARYSOCIETY

### **Planetary Exploration Budget Dataset:**

https://www.planetary.org/space-policy/planetary-exploration-budget-dataset

Compiled by Casey Dreier Senior Space Policy Adviser casey.dreier@planetary.org

Twitter: @CaseyDreier

Bio: https://www.planetary.org/profiles/casey-dreier

Apple Podcasts/Spotify Podcasts: Planetary Radio: Space Policy Edition